PATENT ABSTRACTS OF JAPAN

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(54) IMAGE PICKUP DEVICE AND CONTROLLING METHOD FOR IMAGE PICKUP DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a device which uses a controlling method that is optimum to each operation state of a vibration proof photographic mode and a pixel shifting photographic mode by changing drive control of an image blurring correcting means according to a selected photographic mode between a photographic mode that corrects image blurring and a photographic mode that synthesizes a high resolution image.

SOLUTION: A CPU 1 is in charge of control over the entire camera. A photographic mode setting means 2 consists of a switch which switches vibration proof photographic mode that is for eliminating image blurring that is caused by hand shake and a pixel shifting photographic mode which is for producing a high-definition imageetc. The sensitivity of a correction system position detecting part 19 is changed according to whether a photographic mode is a photographic mode that premises normal blurring correction or the pixel shifting photographic

mode. And the control is carried out in methods which are optimum to the respective photographic modes in such manners that one makes it possible to perform photographing with a camera in hand by giving priority to stroke and the other drives a correcting lens to an accurate position by giving priority to control resolution.

CLAIMS

[Claim(s)]

[Claim 1]An imaging device comprising:

An imaging means.

A shake detection means which detects deflection.

An image shake correcting means which amends an image shake based on an output of this shake detection means.

minute displacement of the position of an image on said imaging means is carried out using said image shake correcting means -- it ****** carrying out and with a means. An image compositing means which combines a picture of high resolution based on said two or more image data which carried out [******]and was displaced and picturized in a position of said imaging means top image by a meansA control means which changes drive controlling of said image shake correcting means by photographing mode selectable and chosen [the 1st photographing mode aiming at amending an image shake and the 2nd photographing mode aiming at combining a picture of high resolution].

[Claim 2]Claim 1 comprising:

A position detecting means from which said image shake correcting means detects a current position of an amendment part.

A different amplification factor from this position detecting means to an output.

[Claim 3]In claim 1said image shake correcting means is provided with an

amendment optical systemand said control meansTo said image shake correcting meansin said 1st photographing mode. An imaging device constituting so that control which gives priority to making control which gives priority to a movable range over resolution of said amendment optical system performnarrowing a movable range of said amendment optical system in said 2nd photographing modeand raising resolution may be made to perform.
[Claim 4]An imaging devicewherein said control means is provided with a frequency characteristic change means which changes the frequency characteristic of said image shake correcting means according to said photographing mode in claim 1.
[Claim 5]In claim 4said frequency characteristic change meansSet up a frequency characteristic decrease phase lag over a deflection frequency range made into an object of amendment of said image shake correcting means in said 1st photographing modeand in said 2nd photographing mode. An imaging device constituting so that priority may be given to a response at the time of a minute drive of said said image shake correcting means carry out [******] and according to a means and a frequency characteristic may be set up.
[Claim 6]An imaging device with which said frequency characteristic in said 2nd photographing mode is characterized by said thing [being constituted so that it may ****** carry outsaid image shake correcting means may resist static friction by a means and it may be determined based on a response in which a minute drive to a target position is possible] in claim 5.
[Claim 7]An imaging device with which said control means is characterized by constituting an operator arbitrarily so that a change is possible in claim 1.
[Claim 8]An imaging device comprising:
An imaging means.
A shake detection means which detects deflection.
An image shake correcting means which amends an image shake based on an output of this shake detection means.
minute displacement of the position of an image on said imaging means is

carried out using said image shake correcting means -- it ****** carrying out and with a means. An image compositing means which combines a picture of high resolution based on said two or more image data which carried out [******]and was displaced and picturized in a position of said imaging means top image by a meansA control means which changes a signal processing method from said image shake detection means by photographing mode selectable and chosen [the 1st photographing mode aiming at amending an image shake and the 2nd photographing mode aiming at combining a picture of high resolution].

[Claim 9]An imaging device controlling said control means in claim 8 not to perform deflection detection when said 2nd photographing mode is chosen.
[Claim 10]An imaging device controlling said control means in claim 9 not to perform current supply to a shake detection means when said 2nd photographing mode is chosen.
[Claim 11]An imaging device constituting so that energization to said shake detection means may not be performed but a target position of said image shake correcting means may be outputted from said control meanswhen said 2nd photographing mode is chosen in claim 10.
[Claim 12]An imaging device controlling said control means in claim 8 to forbid operation of said image shake correcting means based on an output of a shake detection means when said 2nd photographing mode is chosen.
[Claim 13]In claim 8when said 1st photographing mode is chosensaid control meansAn imaging device constituting so that energization may be started to said shake detection means according to the power supply ON of said imaging device and drive controlling of said image shake correcting means may be carried out based on an output of said shake detection means.
[Claim 14]An imaging means.
A shake detection means which detects deflection.
An image shake correcting means which amends an image shake based on an output of said shake detection means.

minute displacement of the position of an image [image shake correcting means / said] on said imaging means is carried out using said image shake correcting means -- ****** carrying out -- a means.
An image compositing means which combines a picture of high resolution based on said two or more image data which carried out [******]and was displaced and picturized in a position of said imaging means top image by a means.
The 1st photographing mode aiming at being the control method of an imaging device provided with the aboveand amending an image shake by said image shake correcting meansDrive controlling of said image shake correcting means was changed by photographing mode which made selectable the 2nd photographing mode aiming at combining a picture of high resolutionand was chosen.

[Claim 15]In claim 14in said 1st photographing mode. A control method of an imaging device characterized by making control which gives priority to a movable range over resolution of an amendment optical system of said image shake correcting means performand making it make control which gives priority to narrowing a movable range of said amendment optical systemand raising resolution in said 2nd photographing mode perform.
[Claim 16]In claim 15in said 1st photographing mode. Set up a frequency characteristic decrease phase lag over a deflection frequency range made into an object of amendment of said image shake correcting meansand in said 2nd photographing mode. A control method of an imaging device giving priority to a response at the time of a minute drive of said said image shake correcting means carry out [******] and according to a meansand setting up a frequency characteristic.
[Claim 17]An imaging means.
A shake detection means which detects deflection.
An image shake correcting means which amends an image shake based on an output of this shake detection means.

minute displacement of the position of an image on said imaging means is carried out using said image shake correcting means -- ****** carrying out -- a means.
An image compositing means which combines a picture of high resolution based on said two or more image data which carried out [******]and was displaced and picturized in a position of said imaging means top image by a means.
Are the control method of an imaging device provided with the aboveand are selectable in the 1st photographing mode aiming at amending an image shakeand the 2nd photographing mode aiming at combining a picture of high resolutionAnd a signal processing method from said shake detection means was changed by selected photographing mode.

[Claim 18]A control method of an imaging device controlling in claim 17 not to perform deflection detection when said 2nd photographing mode is chosen.
[Claim 19]A control method of an imaging device controlling not to perform energization to said shake detection meansbut to output a target position of said image shake correcting means from said control means in claim 17 when said 2nd photographing mode is chosen.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the imaging device provided with the high-definition-images image pick-up function and image shake correcting function which are depended for ****** carrying out.
[0002]
[Description of the Prior Art]. As [indicate / conventionally / by this kind of digital still camera / by JP7-240932A] There is what is called the method of ******

carrying out of shifting the object image projected on an image sensor spatially and serially using optic-axis deflection meanssuch as a variable vertex angle prism attached to the front face of a taking lensand acquiring the picture of high resolution eventually by compounding each shot data later.

[0003]In the case of this methodin the state of having a predetermined angle which has a variable vertex angle prism first1st photography is performedthe object image at that time is picturized with an image sensoreach of that picture element data is changed into digital data via a read-out A/D converter one by oneand it memorizes in a memory.

[0004]On the other handalthough the next photography is continuously performed also in the midst of performing said read-outin this case -- receiving the first photography in a variable vertex angle prism before a photographing start (for exampleduring V blanking period) -- ** -- the image formation positions of the object image projected on an image sensor come to differ by leaning a fixed quantity compared with the case of the first photography.

[0005]Thereforeif the amount of predetermined displacement of this variable vertex angle prism is chosen suitablythe object image on the image sensor in the first photography and the 2nd photography can make the state where it shifted only one half of each pixel intervals of an image sensorfor example. By such a methodspecified quantity displacement of the variable vertex angle prism is carried out for every photographyand the same shot data in several different spatial positions is independently memorized in the memory.

[0006]Usuallyin the case of 3 board types using separate CCDthe first measure picture is received for every color of R (red)G (green)and B (blue)Next a variable vertex angle prism is driven so that only 1/2 pixel of the directions of X may shiftthe next drives a variable vertex angle prism so that only 1/2 pixel of the directions of Y may shiftand a variable vertex angle prism is driven so that only 1/2 pixel of the directions opposite to the 2nd driving direction of X may finally shift.

[0007]In this wayby compounding 4 times of the obtained shot data by post-

processingit becomes possible to obtain the shot data in which that it is horizontal and vertical has twice as many resolution as this to the shot data obtained from an original image sensor.
[0008]On the other handthe so-called shift correction means which indicated the concrete composition is also used for drawing 3 other than a compensation means using the above-mentioned variable vertex angle prism as what is called a vibration isolation that prevents the image shake by a photography person's shaking hand.
[0009]Although detailed operation of this shift correction means is mentioned laterwhen this enables it to move some lens groups of the optical system of a photographing light study means free on a vertical flat surface to an optic axis and this lens group was moved in predetermined X and the direction of Yit used the variable vertex angle prism mentioned above -- it carries out [******] and the completely same effect as photography is acquired.
[0010]
[Problem(s) to be Solved by the Invention]Howeverabout the difference in the method of the control of an amendment system in the case where the case where carry out [******] and shaking hand prevention is actually performed about the problem in coexistence of a function and an image shake correcting functionand pixel ****** are performedconsideration is not made and it is not indicated at all.
[0011]When actual use is considered and a photography person chooses vibration-proof photographing modea stroke which mainly compensates the amount of shaking hands of the photography person in stock photography is requiredand control of a certain amendment system for it is indispensable.
[0012]On the other handsince exposure of multiple times is required when [at which the photography person mentioned above] it carries out [******] and photographing mode is chosenit is mainly premised on tripod photographyand the position control in the remarkable fine pitch [like] mentioned above becomes indispensable rather than compensating a photography person's shaking hand in

this case.
[0013]thenthe technical problem of this invention is in ****** using vibration-proof photographing mode and providing the imaging device using the optimal control method for the operating state of each photographing modeand the 1st purposeIt is in providing the imaging device which changed the drive controlling of the compensation means itself by the 1st photographing mode that performs vibration-proof photographyand the 2nd photographing mode that carries out [******] and performs photography.
[0014]The 2nd purpose of this invention is with the 1st photographing mode that performs vibration-proof photographyand the 2nd photographing mode that carries out [******] and performs photographyand there is in providing the imaging device which changed the shake sensor processing itself.
[0015]
[Means for Solving the Problem]In order to solve an aforementioned problemaccording to the invention according to claim 1 in this application. An imaging meansa shake detection means which detects deflectionand an image shake correcting means which amends an image shake based on an output of this shake detection meansminute displacement of the position of an image on said imaging means is carried out using said image shake correcting means -- it ****** carrying out and with a means. An image compositing means which combines a picture of high resolution based on said two or more image data which carried out [******]and was displaced and picturized in a position of said imaging means top image by a meansIt is characterized by an imaging device provided with a control means which changes drive controlling of said image shake correcting means by photographing mode selectable and chosen [the 1st imaging mode aiming at amending an image shake and the 2nd photographing mode aiming at combining a picture of high resolution].
[0016]According to the invention according to claim 2 in this applicationin the invention according to claim 1 said image shake correcting meansAt least two or more amplifiers which have a different amplification factor are prepared for an

output from a position detecting means which detects a current position of an amendment partand this position detecting meansand said control means is characterized by an imaging device constituted so that an output of said amplifier may be chosen according to said selected photographing mode.
[0017]According to the invention according to claim 3 in this applicationin the invention according to claim 1 said image shake correcting meansHave an amendment optical system and said control means to said image shake correcting means in said 1st photographing mode. Control which gives priority to a movable range over resolution of said amendment optical system is made to performand in said 2nd photographing modea movable range of said amendment optical system is narrowedand it is characterized by an imaging device constituted so that control which gives priority to raising resolution may be made to perform.
[0018]According to the invention according to claim 4 in this applicationin the invention according to claim 1said control means is characterized by an imaging device provided with a frequency characteristic change means which changes the frequency characteristic of said image shake correcting means according to said photographing mode.
[0019]According to the invention according to claim 5 in this applicationin the invention according to claim 4 said frequency characteristic change meansSet up a frequency characteristic decrease phase lag over a deflection frequency range made into an object of amendment of said image shake correcting means in said 1st photographing modeand in said 2nd photographing mode. It is characterized by an imaging device constituted so that priority might be given to a response at the time of a minute drive of said said image shake correcting means carry out [******] and according to a means and a frequency characteristic might be set up.
[0020]In [according to the invention according to claim 6 in this application] the invention according to claim 5Said frequency characteristic in said 2nd photographing mode is characterized by said imaging device constituted so that it carried out [******]and said image shake correcting means might resist static

friction and might be determined based on a response in which a minute drive to a target position is possible by a means.
[0021]According to the invention according to claim 7 in this applicationin the invention according to claim 1said control means is characterized by an imaging device with which an operator was arbitrarily constituted so that a change was possible.
[0022]A shake detection means which detects an imaging means and deflection according to the invention according to claim 8 in this applicationAn image shake correcting means which amends an image shake based on an output of this shake detection meansminute displacement of the position of an image on said imaging means is carried out using said image shake correcting means -- it ****** carrying out and with a means. An image compositing means which combines a picture of high resolution based on said two or more image data which carried out [******]and was displaced and picturized in a position of said imaging means top image by a meansIt is characterized by an imaging device provided with a control means which changes a signal processing method from said shake detection means by photographing mode selectable and chosen [the 1st photographing mode aiming at amending an image shake and the 2nd photographing mode aiming at combining a picture of high resolution].
[0023]According to the invention according to claim 9 in this applicationin the invention according to claim 8when said 2nd photographing mode is chosen in said control meansit is characterized by an imaging device constituted so that it might control not to perform deflection detection.
[0024]According to the invention according to claim 10 in this applicationin the invention according to claim 9said control means is characterized by a photographing instrument constituted so that it might control not to perform current supply to a shake detection meanswhen said 2nd photographing mode is chosen.
[0025]According to the invention according to claim 11 in this applicationin the invention according to claim 10when said 2nd photographing mode is

chosenenergization to said shake detection means is not performedbut it is characterized by an imaging device constituted so that a target position of said image shake correcting means might be outputted from said control means.

[0026]According to the invention according to claim 12 in this applicationin the invention according to claim 8said control means is characterized by an imaging device constituted so that it might control to forbid operation of said image shake correcting means based on an output of a shake detection meanswhen said 2nd photographing mode is chosen.

[0027]According to the invention according to claim 13 in this applicationin claim 8when said 1st photographing mode is chosensaid control meansAccording to the power supply ON of said imaging deviceenergization is started to said shake detection meansand it is characterized by an imaging device constituted so that drive controlling of said image shake correcting means might be carried out based on an output of said shake detection means.

[0028]A shake detection means which detects an imaging means and deflection according to the invention according to claim 14 in this applicationAn image shake correcting means which amends an image shake based on an output of said shake detection meansminute displacement of the position of an image [image shake correcting means / said] on said imaging means is carried out using said image shake correcting means -- it ****** carrying out and with a means. It is the control method of an imaging device provided with an image compositing means which combines a picture of high resolution based on said two or more image data which carried out [******]and was displaced and picturized in a position of said imaging means top image by a meansThe 1st photographing mode aiming at amending an image shake by said image shake correcting meansIt is characterized by a manufacturing method of an imaging device which changed drive controlling of said image shake correcting means by photographing mode which made selectable the 2nd photographing mode aiming at combining a picture of high resolutionand was chosen.

[0029]According to the invention according to claim 15 in this applicationin the

invention according to claim 14 in said 1st photographing mode. Control which gives priority to a movable range over resolution of an amendment optical system of said image shake correcting means is made to performand in said 2nd photographing modea movable range of said amendment optical system is narrowedand it is characterized by a control method of an imaging device of having made it make control which gives priority to raising resolution performing.
[0030]According to the invention of this application according to claim 16in the invention according to claim 15 in said 1st photographing mode. Set up a frequency characteristic decrease phase lag over a deflection frequency range made into an object of amendment of said image shake correcting meansand in said 2nd photographing mode. It is characterized by a control method of an imaging device of giving priority to a response at the time of a minute drive of said said image shake correcting means carry out [******] and according to a meansand having set up a frequency characteristic.
[0031]A shake detection means which detects an imaging means and deflection according to the invention of this application according to claim 17An image shake correcting means which amends an image shake based on an output of this shake detection meansminute displacement of the position of an image on said imaging means is carried out using said image shake correcting means -- it ****** carrying out and with a means. It is the control method of an imaging device provided with an image compositing means which combines a picture of high resolution based on said two or more image data which carried out [******]and was displaced and picturized in a position of said imaging means top image by a meansIt is characterized by a manufacturing method of an imaging device which changed a signal processing method from said shake detection means by photographing mode which was selectable and was chosen in the 1st photographing mode aiming at amending an image shakeand the 2nd photographing mode aiming at combining a picture of high resolution.
[0032]According to the invention of this application according to claim 18in the invention according to claim 17when said 2nd photographing mode is chosenit is

characterized by a control method of an imaging device controlled not to perform deflection detection.
[0033]According to the invention of this application according to claim 19in the invention according to claim 17when said 2nd photographing mode is chosenenergization to said shake detection means is not performedbut it is characterized by an imaging device constituted so that a target position of said image shake correcting means may be outputted from said control means.
[0034]
[Embodiment of the Invention](A 1st embodiment) Drawing 1 is a block diagram showing the hardware constitutions of whole this inventionand it is CPU as a control means in which 1 manages control of the whole camera in this figureThe vibration-proof photographing mode for removing the image shake which 2 is a photographing mode setting means for setting up a camera's own photographing modefor exampleis produced by a photography person's shaking hand own [in the case of performing the usual stock photography]It comprises a switch for ****** carrying out and changing photographing mode for making a high definition picture because photo multiple times in the state where it installed to the tripod etc.and only a very slight quantity about the picture element pitch of an image sensor shifts the image formation position of an object image and compounds this multiple image for every photography lateretc.
[0035]If it adds18 is a camera operation switch for starting photography of a cameraand expresses the release switch for starting the main switch for starting the current supply to all the circuit systemsand actual photography.
[0036]Next3 expresses the main photographing optical system of this cameraand 4 expresses the optical means for performing what is called pixel ****** that shifts spatially in parallel the object image which carries out image formation on the imaging means 6 so that it may mention later. As this optical meanswhat is called a shift correction optical system as shownfor example in drawing 3 is used here.
[0037]The concrete composition of this shift optical system is explained using drawing 3. In this figure50 is equivalent to the correcting lens group 4 of drawing

1and this correcting lens group 50 to movement to the X axial direction in drawing 3 in the magnetic-circuit unit which comprises the magnetic member 51 which comprises a magnet and a yokeand the winding coil 52It is possible to make it operate free by changing the current amount and current direction which are energized to the winding coil 52. It is possible to make it operate [in a similar manner] free to movement to Y shaft orientations in drawing 3 by changing the current amount and current direction to the winding coil 54 in the magnetic-circuit unit which comprises the magnetic member 53 which comprises a magnet and a yokeand the winding coil 54.
[0038]A actual motion of such a correcting lens group as relative movement quantity to the body tube buck 55IRED56 (for the direction detection of X) and IRED57 which move united with a lens group (for the direction detection of Y)With the combination of PSD58 (for the direction detection of X) and PSD59 (for the direction detection of Y) which have been attached to the body tube buck 55 fixedit has composition optically detected by a non-contact method.
[0039]In additionby changing the current energizing direction to the electromagnetism magnet which 60 is in the state which suspended the drive to the above-mentioned amendment optical systemis a mechanism locking mechanism for fixing the position of the lens group to a prescribed positionand accompanies thisThe height 61 of the lever tip of the above-mentioned mechanism locking mechanism makes a locked position (state where the correcting lens group was fixed in mechanism)and an unlock condition (correcting-lens-group-free state)by whether it jumps into the hollowed part which moves united with the correcting lens group 50or it jumps out. Incidentally63 is a support ball as a doorstop for regulating **** to the optic axis of the correcting lens group 50.
[0040]Although the shift optical system itself is constituted as mentioned abovethe actual position of this shift optical system is detected by the amendment system position detecting means 19 which includes the combination of the above PSD and IRED as mentioned above.

[0041]The concrete circuitry of this amendment system position detecting means is explained using drawing 4. In thisthe optical signal from IRED71 which has emitted infrared light by sending a certain predetermined current enters into PSD70 via the slit 72.
[0042]As for the two photoelectric current Ia and Ib produced in this PSD70that ratio changes according to the position (actually centroid position of the projection image on PSD of an optical signal) into which the optical signal from IRED71 entersrespectivelyand the sum (Ia+Ib) of that current value is proportional to an incident-light-quantity level.
[0043]This current output Ia serves as voltage-output-Va through the current-voltage conversion circuit which comprises the op amplifier 73 and the resistance 74and serves as voltage-output-Vb through the current-voltage conversion circuit where another current output Ib comprises the op amplifier 75 and the resistance 76 similarly.
[0044]Nextthis both voltage-outputs-Va and -Vb input one into the subtractor circuit which consists of the op amplifier 77 and the resistance 787980and 81subtract both outputs hereand generate output Va-Vb. Since this output becomes large at + side as the incidence position of the optical signal from IRED71 approaches the a side of PSD70 with a natural thingand it becomes large at 1 side as an incidence position approaches the b side of PSD70A motion of IRED which moves united with a motion of the shift lens group 50 as shown in drawing 3 is outputted as it is.
[0045]The both outputs of -Va and -Vb are inputted also into the op amplifier 82 and the adder circuit which consists of the resistance 8384and 85add both outputs hereand generate output Va+Vb. The amount of [by the optical signal having entered] signal level adds this output to reference voltage VC of each op amplifierThis voltage is inputted into the IRED driving circuit which comprises the op amplifier 86 of the next stepthe transistor 87the resistance 8889and 91and the capacitor 90and operation which adjusts IRED current automatically is performed so that the output of Va+Vb may become equal to the reference voltage KVC

(>VC) here. Thusif the sum of the signal output from PSD adjusts IRED current so that it may become always fixed irrespective of temperaturethe solid difference of IRED emission poweretc.the output of one Va-Vb will always express the position of a shift lens group correctly.

[0046]Thenthis Va-Vb output is inputted into the op amplifier 92 surrounded by the dotted line Aand the inversed amplification which consists of the resistance 93 and 94and after it performs predetermined amplification hereit connects that output to the AN-A input of A/D converter 98.

[0047]A Va-Vb output is inputted into the op amplifier 95 surrounded by the dotted line Band the inversed amplification which consists of the resistance 96 and 97and after it performs predetermined amplification hereit connects the output to the AN-B input of A/D converter 98.

[0048]Herethe amplification factor of the amplifier of the portion surrounded by the dotted line B is set up more greatly than the amplification factor of the amplifier of the portion surrounded by the dotted line Aand the voltage output per amount of unit image movements on PSD is large.

[0049]Although the absolute position of an amendment system is taken out with the above compositionsince an output can be taken out in a completely similar way also to a motion of the direction of Yexplanation here is omitted.

[0050]Usuallythis shift correction optical system is what is used for the blurring preventive mechanism by the photography person of the whole camera itselfIn this casethe output of BURESENSA 17 (two angular velocity sensors usually called a vibration gyroscope are usedand angle Bure of the circumference of biaxial [different] (a yawa pitch) is detected independently) which detects the amount of Bure of the whole camera is used.

[0051]As composition of this shake sensor and a processing circuitit has specifically become like drawing 2. The output from the vibrator 40 which actually detects angular velocity is taken out via the synchronous detection circuit 41and a resonance drive is again carried out near the resonance frequency of the vibrator itself through the drive circuit 42 from the output.

[0052]Thereforein the resonance frequencythe output from a vibrator serves as a signal by which AM was carried outappearsis detecting the Coriolis force which the vibrator 40 detects through the periodic detector circuit 41and takes out the output equivalent to the usual angular velocity signal.
[0053]The predetermined offset voltage (null voltage) which is also a case where an angular velocity input is 0 exists in the output through this periodic detector circuit 41In order to remove this unnecessary DC voltage ingredientit lets the op amplifier 43the capacitor 44and the active high pass filter circuit that comprises the resistance 4546and 47 passand he cuts the signal component below predetermined frequencyand is trying to input only a required shake signal ingredient into an A/D converter.
[0054]Thereforein drawing 1both the output of the shake sensor 17 and the output of the amendment system position detecting means 19 which detects the current position of a shift correction optical system are inputted into the amendment system control means 20After changing into the data for driving the shift correction optical system 4 according to the concrete control mentioned later hereamendment system driving means 5it is letting it pass and moving a lensand comes to be stabilized in a predetermined image formation facewithout an object image always swaying.
[0055]On the other handthe object image signal which carried out image formation on the imaging means 6 is changed into predetermined digital data as it is also in a series of video signal processing circuits which comprise 6-16.
[0056]The photographic subject brightness information which is equivalent to this charge quantity in it being also with the A/D conversion means 7 is changed into digital data at the same time it reads the electric charge first accumulated over predetermined time by the imaging means 6 (image sensorssuch as CCDare generally used) one by one for every pixel.
[0057]Since the optical colored filter for making each chrominance signalsuch as RGBis stuck on the developing means 6 herethe output signal from an imaging means turns into a signal which shows each color by turnsand appears. In the

actual stage of ** before photographyafter it inputs first the output value from this A/D conversion means 7 into the process treatment circuit 8 and it performs dark level amendmentgamma conversionetc. hereit usually inputs that result into the image compositing circuit 9.

[0058]Hereactual processing in this image compositing circuit is explained using drawing 5. The color filter array of the image sensor currently used for this figure is a general Bayer arrayand is a check of G (green)R (red)and B (blue) line sequential arrangement. Thereforesince not all pixels have information on RGB in the case of the image sensor of a single plateit is common to make the RGB sexual desire news in all the pixel points on an image sensor in the interpolating calculation which uses the matrix procession of 3x3 shownfor example in the center of a figure.

[0059]At drawing 5although the interpolation filter of G differs from the interpolation filter of R/Bwhen making G signal of the position of afor exampleit can ask for it by multiplying the coefficient of the interpolation filter of G by each luminance data of a enclosed with a dotted lineand 8 pixels of its circumferencerespectively.

[0060]In the case of this figurethe coefficient to G output of the position of a is 1and those four directions are 0.25but since G output of this position is 0G data is substantially determined only with the output value of the position of this a. On the other handwhen making G signal of the position of bask by multiplying the coefficient of the interpolation filter of G by each luminance data of a similarly surrounded by the dotted lineand 8 pixels of its circumferencerespectivelybut. In this casesince G output of b position is 0G data in this position is determined using the average value of vertical and horizontal G output.

[0061]Different R/B interpolation filters from G are similarly used about R/Band the R/B data to all the pixel points is determined. Thusas eventually shown in the right end of drawing 5the output of RGB to all the pixel points is generable.

[0062]Each data of RGB computed by the above methods is transmitted to the video memory 15 for every frameand the monitor display means 16 performs the

finder display of a photography screen based on each data on this video memory.
[0063]On the other handat the time of actual photographytransfer direct of each output value through the process treatment circuit 8 is first carried out to the frame memories 11 and 12and full screen data is once memorized here.
[0064]Subsequentlyin the image compositing circuit 9the contents of this frame memory are compounded by the method shown aboveand the RGB data of each pixel are shortly transmitted to the work memory 13.
[0065]In the memory control means 10the contents of this work memory are compressed based on a predetermined compression formatand that result is saved at the external memory 14 (it usually constitutes from nonvolatile memorysuch as a flash memory).
[0066]On the contraryin observing the image data saved at the external memory 14the data is once transmitted to a memory control meansand after performing the completely same expansion process as the compression format set up beforehand hereit transmits the result to the work memory 13. By transmitting the data on a work memory to video memory via the image compositing means 9it lets the monitor display means 16 passand the picture already taken a photograph is displayed on a finder etc.
[0067]Nextthe actual sequence operation as a camera is explained using the flow chart of drawing 9. At the first step 100it is judged first whether MAINSW (equivalent to some camera operation switches 18 of drawing 1 at a main switch) of a camera turns onWhen MAINSW is in an ON state by a photography person's operation hereit progresses to Step 101 promptly and current supply to each whole circuit block shown in drawing 1 is performed.
[0068]Nextin Step 102the operation which changes the signal from the imaging means 6 into a video signal through each circuit of the A/D conversion means 7the process treatment means 8and the image compositing means 9 is started like the method mentioned aboveand the value monitor operation to the video signal is further started at Step 103. Thereforehenceforth [this step 102 and 103]the above-mentioned video-signal processing operation will be repeated for

every frame.
[0069]Thenin Step 104as interruption processing with being actual for ****** carrying out [vibration proof operation or]and performing operation was permitted and mentioned above through deflection detection / amendment interruption processing mentioned laterthe drive of the shift correction optical system 4 is started via the lens driving means 5. Thereforehenceforth [this]deflection detection / amendment interruption processing shown in drawing 12 for every predetermined time interval will be performed during this main operation execution.
[0070]After performing the above-mentioned interruption permission operationit judges what has happened to the photographing mode of the camera in Step 105. In the usual photography for photography with a common photography person's stockit progresses to Step 106and setting out of the photographing mode setting means 2 of drawing 1 sets internal flag PMODE as zeroand progresses to Step 108.
[0071]On the other handwhen setting out of the photographing mode setting means 2 carries out [******] and is set as photography at Step 105internal flag PMODE is set as one at Step 107and it progresses to Step 108.
[0072]In order to judge whether release operation by a photography person was performed at Step 108 after the above-mentioned operationIt detects whether the release SW in the camera operation switch 18 of drawing 1 turns onwhen this switch is still OFFit returns to Step 105 againand the judgment of photographing mode is repeated.
[0073]On the other handwhen a switch is ONit progresses to Step 109the state of internal flag PMODE set up at the above-mentioned steps 106 and 107 here is judgedwhen this flag is 0it progresses to Step 110 and photography and the storage mode 1 are performed.
[0074]Operation of this photography and recording mode 1 is explained using the flow chart of drawing 10. Firstat Step 2001 is substituted for the parameter K for choosing the frame memory which memorizes the output of the process

treatment circuit 8 temporarilyand the frame memory 1 is specified.
[0075]Nextin Step 201it judges whether the accumulation operation of the image data in the imaging means 6 was completedand it stands by here until accumulation is completed.
[0076]By imaging meanssuch as CCDit is usually assumed here that the next charge storage operation is performed even in the midst of having read the generating electric charge one by onesince the electric charge generated by the photoelectric conversion operation is transmitted to a transfer part shortly after the accumulation operation of predetermined time is completed.
[0077]Thereforethe result which carried out process treatment for every picture element data in the following step 202 as mentioned aboveWhen what it memorizes one by one in the frame memory K (in this caseframe memory 1 shown by 11 of drawing 1)and all the picture element data in one frame was memorized for by the frame memory K at Step 203 is detectedit progresses to the following step 204.
[0078]In Step 204the contents of this frame memory are first transmitted to the pixel synthetic circuit 9interpolation operation to the RGB information which runs short for every pixel is performed like the method mentioned above hereand that result is once transmitted to a work memory at Step 205. This operation is continuously performed by one frameand if it detects that processing for one frame was completed at Step 206it will progress to Step 207.
[0079]Steps 207-211 explain the compression method of a actual taken imageand the preserving method of data. At Step 207execution of lossless compression is first set up to the memory control circuit 10 as a method of compressing a actual picture.
[0080]Methodssuch as DPCM (Differential PCM)are used as a concrete compression method in the JPEG form that the type of this lossless compression has defined the standard of compression of a still picture. If it depends on this method in accordance with the idea of modulation-code-izing only the difference of the pixels which adjoin each other among the pixels contained in image

datathis DPCM methodAlthough the compression ratio (the image size / original image size x100 created) to an original image is compressible only to about 50%since any photography photographic subjects can restore the original picture thoroughlyit is fit for usingwhen an original image wants to deteriorate more.

[0081]Thereforeat Step 208lossless compressionsuch as the describing [above] DPCM methodis performed to every [of an original image] block unit (in this caseyou may not necessarily make it a block unit)At Step 209the actually compressed image data is changed into actual compression code data using Huffman encoding (long code length is assigned to the high numerals of the probability of occurrence for short code length at the low numerals of the probability of occurrence) etc.

[0082]Nextthis coded image data is memorized to the external memory 14 one by oneas shown in Step 210and it detects that compression of all the pictures (whole block) and the preservation to external memory were completed at Step 211and ends.

[0083]Although the photography and the storage mode 1 which is the usual photography are ended through such a series of operationsthis deflection detection / amendment interruption processing that processes by performing interrupt operation for every predetermined time interval working is explained by using the flow chart of drawing 12 next.

[0084]This flow chart consists of periodical interruption to the whole control action which mainly explained and mentioned above the interior action of the amendment system control means 20 of drawing 1and data delivery operation.

[0085]Firstat Step 300the conversion operation to digital data is started via the A/D conversion circuit within the amendment system control means 20and nextby Step 301the predetermined time standby of the output of the shake sensor 17 is carried out until this A/D conversion operation is completed. Detection of that the A/D conversion was completed will transmit this conversion result to internal register U at Step 302.

[0086]Nextalthough the highpass filter operation for removing the unnecessary

DC component (the DC offset in the amplifier part which comprises op amplifier 43 grade shown in drawing 2 here is main) contained in the shake sensor 17 is performed by considering this register U as an input in Step 303This operation is explained using the flow chart of drawing 13. As an easy high pass filter circuit hereif primary progress circuits surrounded in the dotted-line part C of drawing 13 are used and this input-and-output transfer characteristic is expressed using operating resistance R_1 and usable capacity value C_1 -- H(S) =VOUT/VIN=S-C_1 and R_1/(1+S-C_1 and R_1)

It becomes.

[0087]using publicly known S-Z transformwhen replacing this transfer characteristic on Z flat surface for expressing in the discrete characteristic -- H(Z) =(a_0+a_1 and Z^{-1})/(1+b_1 and Z^{-1})

It becomes.

[0088]if each coefficient value $a_0a_1$and b_1 are expressed here using sampling-time-intervals T_s of data -- a_0=(2/T_s)/(1/C_1/R_1+2-/T_s)

a_1=(-2/T_s)/(1/C_1/R_1+2-/T_s)

b_1=(1/C_1/R_1 and-2-/T_s)/(1/C_1/R_1+2T $_s$)

It becomes.

[0089]With the above-mentioned converting methodthe predetermined coefficient value is calculated beforehandand this value is set as the internal register A0A1and B1 in Steps 350-352.

[0090]Nextit transmits to the internal register W1 from internal-memory M (WH) which has memorized one of the results of an operation computed by same processing of the sampling timing of 1 time ago in Step 353Thenin Step 354from internal register U to which input data is set as first operationthe multiplication result of the above-mentioned registers B1 and W1 is subtractedand the result is transmitted to another internal register W0.

[0091]In Step 355the multiplication result of the above-mentioned internal registers A0 and W0 is receivedAfter adding the multiplication result of the internal registers A1 and W1 and setting the result as internal register Vin Step

356all the operations of a highpass filter are ended by memorizing the value of the register W0 computed at Step 354 to internal-memory M (WH).

[0092]With the flow chart of drawing 12the value of internal register V which has memorized the above-mentioned highpass result of an operation is again transmitted to internal register U at Step 304 first for the next operation. And in the following step 305the integration operator for changing the angular velocity signal after removing an unnecessary DC component by the above-mentioned operation into an angular displacement signal is performed.

[0093]This integral action is explained using the flow chart of drawing 14. When the primary phase lead lag network surrounded in the dotted-line part D of drawing 14 is used as an easy integration circuit here and this input-and-output transfer characteristic is expressed using operating resistance R_1 and usable capacity value C_1it is H(S) =VOUT/VIN=1/(1+S-C_1 and R_1).

It becomes.

[0094]When replacing this transfer characteristic on Z flat surface for expressing in the discrete characteristicpublicly known S-Z transform as well as a highpass filter operation is usedand it is H(Z) =(a_0+a_1 and Z^{-1})/(1+b_1 and Z^{-1}).

It becomes.

[0095]if each coefficient value $a_0$$a_1$and b_1 are expressed here using sampling-time-intervals T_s of data -- a_0=(2/T_2)/(1/C_1/R_1+2-/T_s)

a_1=(-2/T_s)/(1/C_1/R_1+2-/T_s)

b_1=(1/C_1/R_1-2/T_s)/(1/C_1/R_1+2-/T_s)

It becomes.

[0096]With the above-mentioned converting methodthe predetermined coefficient value is calculated beforehandand this value is set as the internal register A0A1and B1 in Steps 400-402.

[0097]Nextit transmits to the internal register W1 from internal-memory M (WI) which has memorized one of the results of an operation computed by same processing of the sampling timing of 1 time ago in Step 403Thenin Step 404from internal register U to which input data is set as first operationthe multiplication

result of the above-mentioned registers B1 and W1 is subtractedand the result is transmitted to another internal register W0.

[0098]In Step 405the multiplication result of the above-mentioned internal registers A0 and W0 is receivedAfter adding the multiplication result of the internal registers A1 and W1 and setting the result as internal register Vin Step 406all integration operators are ended by memorizing the value of the register W0 computed at Step 404 to internal-memory M (W1).

[0099]The value of internal register V of the integration operator output computed in the above operationAfter transmitting to internal register U at Step 306at Step 307the sensitivity (value which sets up at what rate a shake compensating system is moved to a actual shake signal) based on the zoom position (z) and focusing position (f) of the taking lens 3 of drawing 1According to the function k (zf)it is set as internal register K. And at Step 308multiplication is performed to internal register U which has memorized the above-mentioned integration operator result for the value of this register Kit changes into drive quantity required for a actual shift correction driveand that result is set as the internal register DR.

[0100]Thenin Step 309the state of internal flag PMODE uniquely set up by photographing mode by the whole drawing 9 sequence is distinguished. Heresince the present photographing mode is the usual photographing modeit is 0 about the value of PMODEtherefore thenStep 310 is performed.

[0101]In Step 310input AN-A of A/D converter 98 is chosen to the output from the amendment system position detecting circuit shown in drawing 4. Since the amplifying circuit part surrounded by the dotted line A inputted into AN-A here serves as voltage setting out which covers the whole stroke of an amendment systemdetection of the whole stroke range is possible for it by this A/D converter 98.

[0102]After standing by until it starts actual A/D conversion operation at Step 311 and this conversion is completed at Step 312after performing the above setting outthe result of this A/D conversion is set as internal register U at Step 313.

[0103]In Step 314to the value of this internal register Uthe multiplication of a certain predetermined gain value H_0 is carried outa sensitivity gain (in this casething for doubling actual movement magnitude with a predetermined digital value) is set as a suitable valueand that result is reset to internal register PS.
[0104]Nextin Step 322subtraction with the value of the internal register DR which has memorized the sensor drive quantity detected from the shake sensor outputand the value of internal register PS which has memorized the present amendment system position output value detected with the described method is performedandas a resultDR-PS is set as internal register U. The value set as this internal register U is the difference of this timeactual swing quantityand the correction amount in the amendment optical system at that timeand if both sensitivity is adjusted beforehand correctlyoriginally both difference should be set to 0. Actuallyas Step 323 showedthe multiplication of a certain predetermined gain value LPG (usually gain of a feedback system) is carried out to these both difference quantitythat difference quantity is amplifiedand it is again set as internal register U.
[0105]At Step 324the phase compensation operation for operating feedback of a whole control system stably is performed to the value of this internal register U. To this phase compensation operationit explains using the flow chart of drawing 15.
[0106]If the phase-lead-compensation circuit surrounded in the dotted-line part E of drawing 15 is used as a standard phase compensation circuit here and this input-and-output transfer characteristic is expressed using operating resistance $R_1R_2$and usable capacity value $C_1$$H(S)$ =VOUT/VIN=(R_2+S-$C_1R_1$and R_2)/(R_1+R_2+S-$C_1R_1$and R_2)
It becomes.
[0107]The publicly known S-Z transform same with having mentioned above when replacing this transfer characteristic on Z flat surface for expressing in the discrete characteristic is usedand it is $H(Z)$ =(a_0+a_1 and Z^{-1})/(1+b_1 and Z^{-1}).
It becomes.

[0108]If each coefficient value $a_0a_1$and b_1 are expressed using sampling-time-intervals T_S of dataherea$_0$=$(1/C_1/R_1+2-/T_s)/(R_1+R_2)$ $(/C_1/R_1/R_2+2T_s)$
$a_1=(1/C_1/R_1-2/Ts)/(R_1+R_2)$ $(/C_1/R_1/R_2+2T_s)$
$b_1=(R_1+R_2)$ $(/C_1/R_1/R_2-2T_s)/(R_1+R_2)/C_1/R_1/R_2+2/T_s$
It becomes.
[0109]With the above-mentioned converting methodthe predetermined coefficient value is calculated beforehandand this value is set as the internal register A0A1and B1 in Steps 450-452.
[0110]Nextit transmits to the internal register W1 from internal-memory M (WS) which has memorized one of the results of an operation computed by same processing of the sampling timing of 1 time ago in Step 453Thenin Step 454from internal register U to which input data is set as first operationthe multiplication result of the above-mentioned registers B1 and W1 is subtractedand the result is transmitted to another internal register W0.
[0111]In Step 455the multiplication result of the above-mentioned internal registers A0 and W0 is receivedAfter adding the multiplication result of the internal registers A1 and W1 and setting the result as internal register Vin Step 456all phase compensation operations are ended by memorizing the value of the register W0 computed at Step 454 to internal-memory M (WH).
[0112]Nextat Step 325the value of internal register V which has memorized this phase compensation result of an operation is reset to internal register Uand it changes into the data of an analog via the D/A converter in which this result of an operation is not illustrated at Step 326and is considered as the input data to the amendment system driving means 5. And an amendment system will be driven to a determined direction via the magnetic circuit eventually performed by explanation of the shift correction unit of drawing 3.
[0113]Thusdifference with the position quantity of an amendment system to actual swing quantity can be taken for every predetermined time intervaland shake compensating can always be correctly realized by always carrying out feedback control of the amendment system to it being also at the current amount

which amplified that differencewithout being influenced by fricative etc. Although this operation explained only the shake compensating of the circumference of the direction of a single shaftsince operation is completely the sameexplanation here is omitted also to another axis.

[0114]Although deflection detection / amendment interruption processing under photography and recording-mode 1 execution of drawing 10 is completed as mentioned aboveFinallyin Step 112 of the whole drawing 9 sequenceit judges whether the release SW of a camera turns offif the release SW continues being oneit remains in Step 112 as it isand when OFF is detectedit will return to Step 108 again.

[0115]On the other handat Step 109 of the camera sequence of drawing 9when the state of internal flag PMODE set up by the state of the photographing mode setting means 2 of drawing 1 is 1it progresses to Step 111 shortlyand it carries out [******] and the photography and the storage mode 2 which is photographing mode are performed.

[0116]It carries out [******] here and it is explained using drawing 6 what kind of thing photography is. The upper figure is what expressed RGB each arrangement of the original image typicallyand has formed the Bayer array mentioned above.

[0117]The image data from which only 1 picture element pitch shifted the data of this original image horizontally to the original image as shown in the leftmost end under drawing 6 by carrying out specified quantity part eccentricity of the amendment optical means 4 of following one-frame term period drawing 1 in the direction of X can be obtained.

[0118]this 1st ****** et al. [therefore] -- carrying out -- it is possible to receive for every color theoretically and to improve the spatial frequency of a horizontal picture twice.

[0119]the 2nd time -- ****** carrying out -- coming out -- as opposed to an original image as been the 1st above-mentioned thing it carries out [******] and is shortly done in the direction of Xand the direction of Y for the specified quantity

eccentricity of the amendment optical means 4 with a state and shown in the center under drawing 6 -- an oblique direction -- a half a pixel pitch -- the image data shifted can be obtained.
[0120]It carries out [******]and thenit is the 2nd thing it carries out [******] and only the direction of X does for the eccentricity of the amendment optical means 4 again with a stateand the image data from which only the half-picture element pitch shifted to the oblique direction to the 3rd original image as shown in the right end under drawing 6 can be obtained. In this wayto an original imageit shifts the predetermined picture element pitch every for every frameand it becomes possible by compounding and combining a total of 4 times of photographed image data for level and a perpendicular direction to raise the spatial frequency of a picture to about twice [about].
[0121]Nextit explains using this actual photography and storage mode 2 that was ****** carried out and was shown in the flow chart of drawing 11 about photography. Firstat Step 2501 is substituted for the parameter K for choosing a frame memory which memorizes the output of the process treatment circuit 8 temporarilyand the frame memory 1 is specified.
[0122]Nextin Step 251it judges whether the accumulation operation of the image data in the photographing device 6 was completedand it stands by here until accumulation is completed. By imaging meanssuch as CCDeven while the electric charge generated by the photoelectric conversion operation has read the generating electric charge one by one since it is promptly transmitted to a transfer part if the accumulation operation of predetermined time is completedit is usually assumed here that the next charge storage operation is performed.
[0123]After the image accumulation operation of an original image as shown in drawing 6 is completednext in Step 252 and Step 253. The eccentric data volume of the amendment optical means for realizing the 1st pixel ******delta X (K)and deltaY (K) are set upand the eccentric drive of the amendment optical means 4 is actually carried out via the lens driving means 5.
[0124]In this casesince only 1 picture element pitch is quantity that a

photographic subject shifts on an imaging surface and deltaY (1) does not carry out eccentricity in the direction of Y to an original imagethe first eccentricity delta X (1) is 0.
[0125]Thereforethe result of having carried out process treatment of the original image for every picture element data in the following step 254It memorizes one by one in the frame memory K (in this caseframe memory 1 shown by 11 of drawing 1)and when it detects that all the picture element data in one frame was memorized at Step 255 subsequently to the frame memory Kit progresses to the following step 256.
[0126]In Step 256the judgment of whether a deed and when not equalthe value of K was counted up one time at Step 257and the accumulation of one frame as follows completed again the judgment of whether the value of the above-mentioned frame memory setting-parameters K is equal to N (in this case4) at Step 251 is performed.
[0127]if completion of image accumulation is detected at Step 251shortlyare Step 252 and Step 253 and delta X (2) and deltaY (2) receive an original image -- an oblique direction -- a half a pixel pitch -- after setting up a value which is shiftedoperation of said steps 254-257 is repeated.
[0128]furthermore -- the case where Steps 252 and 253 are performed once again -- next time -- delta X (3) -- said the 2nd time -- receiving ****** carrying out -- horizontal -- a 1-pixel pitch -- a value which is shifted is set up and deltaY (3) is set to 0.
[0129]Processing can be repeated until the value of K becomes equal to N (in this case4) at Step 256 as mentioned aboveand as shown in drawing 6the picture of four frames which shifted in X and the direction of Y the predetermined picture element pitch every for every frame can be acquired.
[0130]It is drawing 7 which carried out [******] and expressed [above-mentioned] the situation of photography along with the motion of the amendment optical means 4 to a slight degree. This drawing 7 is what showed actual X of the amendment optical means 4 and motion of the direction of Y to the time-axis

tThe amendment system is driven based on the shake sensor outputafter the 1st photography (end of image accumulation)only the direction of X carries out eccentric movement only of delta X (1) in parallelandas for the amendment optical means 42nd photography is performed in this state in the beginning.
[0131]After the 2nd end of photographyshortlyeccentric movement only of delta X (2) and the deltaY (2) is carried out in X and the direction of Yrespectivelyand also 3rd photography is performed. Againafter the 3rd end of photographyonly the direction of X will carry out eccentric movement only of delta X (3)will perform 4th photographyand will complete all.
[0132]next -- Step 258 or subsequent ones -- actually -- ****** et al. -- carrying out -- operation which actually changes the obtained high-density image data into RGB information is performed. At Step 258the value of the parameter K which specifies the frame memory which has memorized the image data which was ****** carried out and was incorporated by the 1st photography by photography is first set as 1.
[0133]Thenthe contents of this frame memory are first transmitted to the image compositing circuit 9Hereunlike the case of the photography and the storage mode 1 mentioned aboveinterpolation operation to the RGB information which runs short for every pixel promptly is not performedbut only the judgment of whether transmission for one frame was completed at Step 260 as it is is performed.
[0134]If it detects that transmission for one frame was completed at Step 260in order to detect that progressed to Step 261 and transmission of all the photographed image data was completed here this timeit is judged whether the value of K is equal to N (in this case4). When transmission of all the photographed image data has not been completed yetthe value of K is counted up one time at Step 262it progresses to Step 259 againand transmission of the contents of the following frame memory is started.
[0135]If transmission of all the shot data is completed eventuallythe value of K will become equal to N at Step 261then it will progress to Step 263and actual

composition of all the photographed image data will be performed for the first time here.
[0136]The situation of this picture composition is explained using drawing 8. The left end of this figure is what rearranged spatially the arrangement of the picture element data which carries out [******] and is obtained behindand is image data arrangement in which that it is horizontal and vertical has about [abbreviated 2 twice] spatial frequency as compared with the image data of the image sensor of the original Bayer array shown in drawing 5.
[0137]Howeverin order level and to acquire perpendicularly each RGB information are twice many as thisalso in this caseit is necessary to cover the interpolation filter which comprises a matrix procession shown in the center of this figure over this image data.
[0138]Although it is about G ingredient firstand the matrix procession of 3x3 same in this case as the former is enoughwhen making G signal of the position of afor exampleit can ask by multiplying the coefficient of the interpolation filter of G by each luminance data of a enclosed with a dotted lineand 8 pixels of its circumferencerespectively.
[0139]In this casealthough the coefficient to G output of the position of a is 1 and those four directions are 0.25since G output of this position is 0G data is substantially determined as the position of this a only with an output value.
[0140]On the other handwhen making G signal of the position of bcan ask by multiplying the coefficient of the interpolation filter of G by each luminance data of b similarly surrounded by the dotted lineand 8 pixels of its circumferencerespectivelybut. In this casesince there is no G signal of the position of bG data in this position is determined using the average value of vertical and horizontal G signal.
[0141]Nextreceive horizontallyand can interpolate from the next picture element data immediately so that it may understandeven if it is complicated to a slight degree about R/B and sees the arrangement at the left end of this figurebut. Since it is necessary to interpolate using the picture element data of the position

which left some to the perpendicular directionthe matrix procession of 5x5 is usedand moreoverit sees from the center of a matrix procession like formerand has become the coefficient arrangement which is not point symmetry.
[0142]The RGB information over all the pixel arrangement like [at the right end of drawing 8] is eventually computable by performing the above operations for every pixel arrangement of all the to each RGB.
[0143]Nextin Step 264since the image data which carried out picture composition from this four photography is actually compressed and savedthe whole of this data is once first transmitted to the work memory 13. Thenin Step 265it sets up performing lossy compression (when a reset action is performed on a basisthe completely same thing as a actual original image is not made) as a compression type to the memory control circuit 10.
[0144]In the JPEG form of having defined the standard of compression of a still picture as the method of this lossy compressionFor exampleafter dividing into the block in every 8x8 pixelsthere are what is called DCT (Discrete Cosine Transform) conversion etc. that are changed into the two-dimensional frequency data of each pictureand according to this methodthe data volume of an original image can be reduced considerably.
[0145]Thereforeexecution of actual compression operations at Step 266 lossy compressionsuch as the describing [above] DCT methodIt carries out [******]and performs [above-mentioned] to next image composing to every block unit (it is 1 block about 8x8 pixels)and the actually compressed image data is changed into actual compression code data like the case of photography and the storage mode 1 at Step 267 using Huffman encoding etc. This coded image data is memorized to the external memory 14 one by oneas shown in Step 268detects that compression of all the pictures (whole block) and the preservation to external memory were completed at Step 269and is completed.
[0146]Nextdeflection detection / amendment interruption processing in the midst of performing this photography and storage mode 2 is again explained using drawing 12. In drawing 12it is as having already explained operation of Steps

300-308and explanation here is omitted.

[0147]In Step 309since the value of internal flag PMODE set up by the photographing mode judging of the camera is distinguishedit carries out [******] for outputting a high definition picture in this case and it is set as photographing modeAN-B is chosen as an input which progresses to Step 315 and performs an A/D conversion.

[0148]As shown in drawing 4the output of the inverting amplifier section B surrounded by the dotted line is connected to this AN-B input as the final output of a shift correction optical systemand this amplifier B has a large amplification factor compared with another amplifier Aand has become what expanded near the inner center of a stroke of the whole amendment system. Thereforeif this output is read by an A/D convertercompared with the case where the output of the amplifier A is readit will become possible to realize higher definition position control.

[0149]At Step 316A/D conversion operation of a actual amendment system position output is startedand he judges whether this A/D conversion operation was completed at Step 317he follows that A/D conversion operation was completed to Step 318 with ******and the result of an A/D conversion is transmitted to internal register U.

[0150]In Step 319the multiplication of a certain predetermined gain value H_1 is carried out to the value of this internal register Uand it is a sensitivity gain (in this caseit is a thing for doubling with a predetermined digital valueand actual movement magnitude). The gain of amplifier part B sets setting out as a small value at a suitable value compared with a large part and gain H_0 compared with amplifier part Aand resets the result to internal register PS.

[0151]nextit mentioned above in Step 320 -- it carried out [******] and has set up at Steps 252 and 253 at the time of photographing mode -- it ****** carrying out and to the value of the quantity DRX (or DRY). The multiplication of the value of the variable value K uniquely determined according to the zoom and the focus condition of a photographing optical system is carried outand the result is set as

the internal register DRS.
[0152]The value of this DRX and DRY at the time of the 0 or 2nd photography at both the times of the 1st photography DRX=delta X (1)DRY = each value of DRX=delta X (3) and DRY=0 will be set up before each actual photographing start at the time of DRX=delta X (2)DRY=deltaY (2)and the 4th photography at the time of the 0 or 3rd photography.
[0153]Thenin Step 321the value of the amendment system drive quantity DR based on the shake sensor output for which it has opted at Step 308and the value of the amendment [this ****** et al.] system drive quantity DRS come out by carrying out are addedand that result is again set as the internal register DR.
[0154]After thatit is performing operation of Steps 322-326 mentioned aboveand the difference of actual amendment system drive quantity and an amendment system position detection system is calculatedsetting out and phase compensation of a suitable loop gain are performedit changes into amendment system drive dataand this deflection detection / amendment interruption processing is ended.
[0155]Thusit carries out [******] andin the case of photographing modethe amendment stroke which fully amends a actual shaking hand becomes difficult on a detection rangebut the whole composition is changed so that the detecting position resolution in the range of that part specification may be raised.
[0156]Complete photography and the storage mode 2 of drawing 11 as mentioned aboveand it is judged whether finally the release SW of a camera turns off at Step 112 of drawing 9If the release SW continues being oneit remains in Step 112 as it isand when come by offit will return to Step 108 again.
[0157]By this exampleabove by whether the photographing mode of a camera is the photographing mode on condition of the usual hand shake correctionor for it to ****** carry out and to be photographing mode for outputting a high definition picture. The sensitivity of an amendment system position detector is changedone side enables stock photography sufficient by giving priority to a strokeand another side performs control by the method which was most suitable for each

photographing mode as a correcting lens is driven in an exact position by giving priority to the resolution of control.
[0158]When the photographing mode of the camera is specifically set as vibration-proof photographing modePriority is given to the stroke range of an amendment optical systemand resolution is read in the coarse stateand when photographing mode carries out [******] and is set as photographing mode on the other handthe stroke of an amendment optical system is narrowed and is made to make resolution fine.
[0159]Control of an amendment optical system reads the position of the lens itself like a described methodfeedback control is performed so that that position may be in agreement with a target signalbut the frequency characteristic of this control system itself is changed by photographing mode.
[0160]For examplesince the signal from 1 Hz to 20 Hz equivalent to a shaking hand is detected and amended in the case of vibration-proof photographing modedetermine the whole frequency characteristic so that the phase lag of an amendment system in the range may become small as much as possiblebut. Since it carries out [******] and only very small displacement drives an amendment optical system in photographyit becomes an important point of characteristic determination how it is made to move to the position of the following which resists static friction and serves as a target correctly.
[0161](A 2nd embodiment) The 2nd example of this invention is described by using the flow chart of drawing 16 next. Like deflection detection / amendment interruption processing of drawing 12during processing execution of photography and the storage mode 1 of drawing 11and photography and the storage mode 2 of drawing 12this flow chart performs interrupt operation periodicallyand performs predetermined processing.
[0162]Firstalthough operation of Steps 500-508 is completely the same as operation of Steps 300-308 and detailed explanation here is omittedAfter changing the output from a shake sensor into digital data via an A/D converterAfter removing an unnecessary DC component via a highpass filter and

also changing into angular displacement quantity via an integration operatorthe target driving quantity to a actual deflection detected amount is computed by processing the shift correction sensitivity based on the zoom state and focus condition of a photographing optical system.
[0163]Nextin Step 509AN-A is chosen as an input of an A/D converterand the inverting amplifier section A is chosen as a position detection process of the amendment optical system of drawing 4. Thereforethe whole stroke of a shift correction optical system will be incorporated via an A/D converter in this case.
[0164]In Step 510A/D conversion operation of an amendment system position output is actually startedat Step 511after standing by until the A/D conversion operation is completedwhen conversion is completedit progresses to Step 512and the conversion result is set as internal register U.
[0165]In Step 513to the value of this internal register Uthe multiplication of a certain predetermined gain value H_0 is carried outa sensitivity gain (in this casething for doubling actual movement magnitude with a predetermined digital value) is set as a suitable valueand that result is reset to internal register PS.
[0166]Nextin Step 514the state of internal flag PMODE uniquely set up by the photographing mode of the camera is distinguished. When the photographing mode of a camera is normal photographing modesince the value of PMODE is 0it will progress to Step 517 as it isbut it carries out [******] for the photographing mode of a camera to output a high definition pictureand in the case of the modethe value of PMODE is 1 and performs Step 515 or subsequent ones in this case.
[0167]firstby Step 515as mentioned aboveit carried out [******] and has set up at Steps 252 and 253 at the time of photographing mode -- it ****** carrying out and to the value of the quantity DRX (or DRY). The multiplication of the value of the variable value K uniquely determined according to the zoom and the focus condition of a photographing optical system is carried outand the result is set as the internal register DRS. The value of this DRX and DRY is the same as the value mentioned above.

[0168]Thenin Step 516the value of the amendment system drive quantity DR based on the shake sensor output for which it has opted at Step 508and the value of the amendment [this ****** et al.] system drive quantity DRS come out by carrying out are addedand that result is again set as the internal register DR.
[0169]Nextin Step 517subtraction with the value of the internal register DR which has memorized the sensor drive quantity detected from the shake sensor outputand the value of internal register PS which has memorized the present amendment system position output value detected with the described method is performedand the result is set as internal register U. The value set as this internal register U is the difference of this timeactual swing quantityand the correction amount in the amendment optical system at that timeand if both sensitivity is adjusted beforehand correctlyoriginally both difference should be set to 0.
[0170]At Step 518the state of internal flag PMODE is distinguished againwhen the value of PMODE is 0it progresses to Step 519and the multiplication of a certain predetermined gain value LPG_1 (usually gain of a feedback system) is carried out to the value of this register Uand it is again set as internal register U.
[0171]To the value of this internal register Uat Step 520in order to operate feedback of a whole control system stablyphase compensation operation-1 is performed. Although this phase compensation operation-1 is realized by performing a predetermined operation according to the flow chart of drawing 15 mentioned aboveeach of that constant value can be uniquely determined by setting up each value of R1 of the right figureR2and C1.
[0172]He is trying to acquire a frequency characteristic as shown in (a) of drawing 17and (b) by setting the constant as a suitable value here. the characteristic of this drawing 17 is what showed the closed loop characteristics of the shift correction optical system at the time of performing the above-mentioned phase compensation operation-1and can cover the frequency band of a shaking hand (about 20 Hz) -- as -- about 100 Hz -- until -- the gain maintained 1and it has set up so that phase lag may also decrease if possible.

[0173]On the other handas a result of judging the state of internal flag PMODE at Step 518when the value of PMODE is 1it progresses to Step 521The multiplication of a certain predetermined gain value LPG_2 (usually gain of a feedback system) is carried out to the value of this register Uand it is again set as internal register U.
[0174]At Step 522phase compensation operation-2 for operating feedback of a whole control system stably is performed to the value of this internal register U. This phase compensation operation-2 is a thing for performing control for which it was suitable when a photograph was taken by ****** carrying out unlike phase compensation operation-1and the frequency characteristic of the shift correction optical system at the time of performing this operation becomes as [showed / in drawing 17 (c) and (d)]. In the case of this characteristicfrom removing a actual photography person's shaking handit carried out [******]and with emphasis on the accuracy of position of the amendment optical system for photographythe closed loop gain in the neighborhood near DC is close to 1 as much as possibleand the phase lag of an about [several Hz] is set up as much as possible it be few.
[0175]Nextat Step 523the value of internal register V which has memorized this phase compensation result of an operation is reset to internal register Uand it changes into the data of an analog via the D/A converter in which this result of an operation is not illustrated at Step 524and is considered as the input data to the amendment system driving means 5. And an amendment system will be driven to a determined direction via the magnetic circuit eventually performed by explanation of the shift correction unit of drawing 3.
[0176]Control which changed the frequency characteristic of the actual amendment optical systemand was [for outputting a high definition picture] suitable for both photographing modes by whether the photographing mode of a camera is the mode on condition of the usual vibration-proof photography or for it to ****** carry out and to be photographing mode is performed above at this example.

[0177](A 3rd embodiment) A 3rd embodiment of this invention is described by using the flow chart of drawing 18 next. In this examplein the whole sequence shown in the flow chart of drawing 9deflection detection / amendment interruption processing of drawing 18 is performedand the control action is changed according to the setting-out photographing mode of a camera.
[0178]At Step 550the state of internal flag PMODE first set up uniquely by the photographing mode of the camera is distinguishedand when this value is 0Step 551 or subsequent ones is performed. Steps 551-559 -- until -- it being completely the same even as Steps 300-308 of drawing 12andAfter changing the output from a shake sensor into digital data via an A/D converteran unnecessary DC component is removed via a highpass filteran integration operator is performedand it changes into angular displacement quantity. Thereforethe target driving quantity DR of shake compensating is eventually computed at Step 559.
[0179]On the other handwhen the value of internal flag PMODE is 1 at Step 550it carries out [******] for the photographing mode of a camera to output a high definition pictureand is set as photographing modeand shake sensor processing to the above-mentioned steps 551-559 is not performed in this casebut Step 560 or subsequent ones is performed directly.
[0180]Nextin Step 560AN-A is chosen as an input of an A/D converterand the inverting amplifier section A is chosen as a position detection process of the amendment optical system of drawing 4. Thereforethe whole stroke of a shift correction optical system will be incorporated via an A/D converter in this case.
[0181]In Step 561A/D conversion operation of an amendment system position output is actually startedat Step 562after standing by until the A/D conversion operation is completedwhen conversion is completedit progresses to Step 563and the conversion result is set as internal register U.
[0182]In Step 564to the value of this internal register Uthe multiplication of a certain predetermined gain value H_0 is carried outa sensitivity gain (in this casething for doubling actual movement magnitude with a predetermined digital value) is set as a suitable valueand that result is reset to internal register PS.

[0183]Nextin Step 565the state of internal flag PMODE uniquely set up by the photographing mode of the camera is distinguished again. When the photographing mode of a camera is normal photographing modesince the value of PMODE is 0it will progress to Step 569 as it isbut it carries out [******] for the photographing mode of a camera to output a high definition pictureand in the case of the modethe value of PMODE is 1 and performs Step 566 or subsequent ones in this case.

[0184]At Step 566the value of the internal register DR in which the value of the target driving quantity of an amendment system is set up is first cleared to 0. Thereforeit will ****** carry out andin the case of photographing modethe output from a shake sensor will be used at all.

[0185]nextin Step 567as mentioned aboveit carried out [******] and has set up at Steps 252 and 253 at the time of photographing mode -- it ****** carrying out and to the value of the quantity DRX (or DRY). The multiplication of the value of the variable value K uniquely determined according to the zoom and the focus condition of a photographing optical system is carried outand the result is set as the internal register DRS. The value of this DRX and DRY is the same as the value mentioned above.

[0186]Thenin Step 568the value of the amendment system drive quantity DR cleared by 0 at the above-mentioned step 566 and the value of the amendment [this ****** et al.] system drive quantity DRS come out by carrying out are addedand that result is again set as the internal register DR.

[0187]Nextin Step 569subtraction with the value of the internal register DR which has memorized the sensor drive quantity detected from the shake sensor outputand the value of internal register PS which has memorized the present amendment system position output value detected with the described method is performedand the result is set as internal register U. The value set as this internal register U is the difference of this timeactual swing quantityand the correction amount in the amendment optical system at that timeand if both sensitivity is adjusted beforehand correctlyoriginally both difference should be set

to 0.
[0188]In Step 570the multiplication of a certain predetermined gain value LPG (usually gain of a feedback system) is carried out to the value of this register Uand it is again set as internal register U.
[0189]At Step 571the phase compensation operation for operating feedback of a whole control system stably is performed to the value of this internal register U. Although this phase compensation operation is realized by performing a predetermined operation according to the flow chart of drawing 15 mentioned aboveeach of that constant value can be uniquely determined by setting up each value of R1 of the right figureR2and C1.
[0190]Nextat Step 572the value of internal register V which has memorized this phase compensation result of an operation is reset to internal register Uand it changes into the data of an analog via the D/A converter in which this result of an operation is not illustrated at Step 573and is considered as the input data to the amendment system driving means 5. And an amendment system will be driven to a determined direction via the magnetic circuit eventually performed by explanation of the shift correction unit of drawing 3.
[0191]This example performs above control which changed the signal processing from a shake sensor itselfand was [for outputting a high definition picture] suitable for both photographing modes by whether the photographing mode of a camera is the mode on condition of the usual vibration-proof photographyor for it to ****** carry out and to be photographing mode.
[0192]Since it carries out [******] and no output from a shake sensor is used in the case of photographing mode as mentioned above in this exampleit is also possible to suspend the current supply to the shake sensor 17 via the whole drawing 1 control means.
[0193]When the photographing mode of the camera is set as vibration-proof photographing modewhile the main switch of a camera is set to ONthe energization to a shake sensor is startedsignal processing of the output is carried outandspecificallythe drive controlling of an amendment optical system is started

based on the result. When the photographing mode of a camera carries out [******] and is set as photographing modeeven if the main switch of a camera is set to ONenergization to a shake sensor is not performedbut a control system is driven according to the target position signal generated inside a control system.
[0194]Thusthe efficient control of the setting-out photographing mode of the camera itself is attained by [for capturing the vibration-proof photographing mode for removing a photography person's shaking handand a high definition image] ****** carrying out and changing the processing of a shake sensor itself by photographing mode.
[0195]
[Effect of the Invention]As explained abovewhen the photographing mode of the camera itself which the photography person set up is the usual vibration-proof photographing mode according to this applicationIn order to remove the influence of a photography person's shaking handthe sensitivity of a processing circuit system is set up give priority to an amendment stroke as a detecting position of an amendment systemSince an amendment system can be correctly driven to a position by setting up the sensitivity of a processing circuit system so that it may ****** carry out for on the other hand outputting a high definition picture and priority may be given to detection power over an amendment stroke in the case of photographing modeit is effective in maintaining the optimal accuracy of an amendment system in two different photographing modes.
[0196]When photographing mode is usually photography according to this applicationThe frequency characteristic of an amendment optical system is set to shaking hand frequency at largefor examplethe value that it receives and a certain amount of control rate (capability to hold down the amount of image shakes on each frequency axis a table under thing) is obtained(to several 10 Hz)On the other handphotographing mode carries out [******]and when it is photographing modein order to set up the frequency characteristic of an amendment optical system so that performance sufficient near DC can be pulled outalso in any of two different photographing modesit is effective in the ability to

pull out sufficient dynamic characteristics of an amendment optical system.
[0197]According to this applicationwhen photographing mode is usually photographyusually passperform the operation to a shake sensor outputand drive a shake correction optical system by making the output into a target signalbut. Photographing mode carries out [******]and when it is photographing modeno operation to a shake sensor is performedSince it was made to drive an amendment system based on the driving signal for only changing the image pickup position of an object image for every photographyit carries out [******] and can shorten calculation time at the time of photographyand. Do not receive the adverse effect by the misbelief item (signals other than the deflection output of original [shake sensor / itself] are generated by mechanical vibration etc. which are generated inside a camera) of the shake sensor at the time of tripod photographyetc.etc.andIf the current supply of the shake sensor itself is suspendedit is not necessary to send unnecessary current and is effective in leading also to energy saving.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is an entire configuration figure of the camera concerning whole this invention.
[Drawing 2]It is a lineblock diagram of a shake sensor and a processing circuit system.
[Drawing 3]It is a lineblock diagram of a shift correction system.
[Drawing 4]It is a lineblock diagram of the position detection process circuit of a shift correction system.
[Drawing 5]It is a figure explaining the method of the color composition at the time of using the usual image sensor.
[Drawing 6]It is a figure explaining the principle of pixel ****** concerning whole

this invention.

[Drawing 7]It is a figure explaining actual operation of pixel ****** concerning whole this invention.

[Drawing 8]It is a figure explaining the color composition at the time of performing pixel ****** concerning whole this invention.

[Drawing 9]It is a figure showing the whole camera sequence concerning whole this invention.

[Drawing 10]It is a figure explaining photography and storage operation of the camera concerning whole this invention.

[Drawing 11]It is a figure explaining photography and storage operation of the camera concerning whole this invention.

[Drawing 12]It is a figure showing operation of the deflection detection and amendment concerning the 1st example of this invention.

[Drawing 13]It is a figure showing operation of the shake sensor highpass operation concerning whole this invention.

[Drawing 14]It is a figure showing operation of the shake sensor integration operator concerning whole this invention.

[Drawing 15]It is a figure showing operation of the amendment system phase compensation operation concerning whole this invention.

[Drawing 16]It is a figure showing operation of the deflection detection and amendment concerning the 2nd example of this invention.

[Drawing 17]It is a figure showing the frequency characteristic of an amendment system concerning the 2nd example of this invention.

[Drawing 18]It is a figure showing operation of the deflection detection and amendment concerning the 3rd example of this invention.